ME-86-02

Verglimit Pavements in Ontario
— An Interim Report

Ontario
Ministry of Transportation and Communications
Research and Development Branch

86-06408/

Technical Report Documentation Page

Verglimit Pavements in Ontario
— An Interim Report

Author: J.E. Gruspier, Research Engineer, Materials Research Office

MTC No.: ME-86-02

Date: August 1986

Published by: The Research and Development Branch
Ontario Ministry of Transportation and Communications

Participating Agencies/-Client:

Abstract: This report summarizes a decade of MTC experience with Verglimit — a European anti-icing compound incorporated in bituminous concrete. Road condition reports and accident experience are compiled for the various Verglimit test sections in southern Ontario.

Findings indicate that Verglimit has been effective in reducing icing in about 50% of the trial pavement sections and bridge decks. It was also found that Verglimit should not generally be used in combination with steel slag aggregate due to the thermal properties of the latter.

The incorporation of Verglimit in bituminous concrete pavement surface courses may triple their cost. Nevertheless, consideration of using Verglimit in asphalt surfaces on bridges, particularly prone to hazard because of icing, appears to be justified.

Key words: Verglimit, de-icing chemicals, snow and ice control, pavements, safety

Distribution: Environmental and municipal works engineers, MTC Districts and Regions, pavement design and maintenance engineers.

Copyright Status: Crown copyright

ME-86-02

Verglimit Pavements in Ontario
— An Interim Report

J.E. Gruspier
Research Engineer
Research and Development Branch

Published by
The Research and Development Branch
Ontario Ministry of Transportation and Communications
Hon. Ed Fulton, Minister
D.G. Hobbs, Deputy Minister

Published without prejudice as to the application of the findings. Crown copyright reserved; however, this document may be reproduced for non-commercial purposes with attribution to the Ministry.

For additional copies, write:
The Editor, Technical Publications
Room 320, Central Building
1201 Wilson Avenue
Downsview, Ontario
Canada M3M 1J8

Telephone: (416) 248-7226
Infotex Electronic Mail: 21:MIN006

August 1986

Table of Contents

Acknowledgements	
1/ Introduction	1
2/ Test Sites	2
3/ Presence of Verglimit	2
4/ Observations of Physical Performance	3
5/ Discussion of Physical Performance	4
6/ Cost of Verglimit Mix	5
7/ Accidents at Verglimit Sites	5
8/ Conclusions and Recommendations	6

List of Tables

1/ Test Site Locations	7
2/ Summary of Physical Performance Observations	8
3/ Summary of Verglimit Performance	10
4/ Accident Data	11
5/ Accident Summary	12

Acknowledgements

The Research and Development Branch gratefully acknowledges the assistance of Maintenance personnel from Districts 2, 4, 6, 7 and 11, who made the field observations.

Thanks also go to G.L. Kelly of the Traffic Management and Engineering Office for providing accident data, and to S.P. Edwards of the Estimating and Engineering Claims Office for providing cost information.

1/ Introduction

Differential icing between a bridge deck and the approaches is a phenomenon which can occur with some frequency in late fall or early spring, or at any time there is a sudden temperature drop below the freezing point during the winter months. The bridge deck is exposed from the top and bottom and thus tends to cool off quickly with falling temperatures such that ice may form on the deck surface if the air is high in humidity or a light rain falls as the temperature drops below 0°C. The approaches, on the other hand, have sufficient heat stored in the ground to prevent ice from forming on the pavement. The difference in the condition of the bridge deck surface and the adjacent pavement may result in an unexpected hazard to safe driving before spot treatment by sanding and salting can be applied.

Verglimit is a patented compound which is designed to reduce this hazard. It is a chemical multi-component de-icer which consists primarily of calcium chloride flakes to which 5% sodium hydroxide and an unknown chemical component is added. The compounded flakes are coated with linseed oil which is polymerized to protect the flakes from water. The compound is incorporated into the asphalt mix at the plant and the surface course mix is laid on the road in the normal manner. As the pavement wears under traffic, new particles of Verglimit become exposed, providing built-in de-icing for the life of the pavement surface.

According to the manufacturer, Verglimit is not intended to melt appreciable accumulations of ice. Instead, it provides a thin film of brine which prevents ice from adhering to the pavement. As the temperature decreases, so does this effect. The Verglimit pavement on a bridge deck should freeze at about the same time as the pavement on the approaches, if it is working as designed, creating a uniform driving condition. A higher effectiveness is to be expected in the first year; however, the results should be consistent in the second, third, and subsequent years according to the manufacturer.

The criteria considered by the Ministry for potential use of Verglimit are:

1) There must be a known slippery condition due to ice formation or else where icing has been observed to occur on bridge decks.

2) Verglimit should not be used where vehicles are stopping, as at an intersection, due to the increased flow value of the mix.

Verglimit is generally added at a rate of 5% by weight to the hot mix which is laid to a compacted thickness of 36 mm. The void content of the surface course pavement is designed to be 3% to 4%.

The purpose of this report is to document Ministry experience with Verglimit trial installations over the last decade with respect to physical performance, accidents and cost.

2/ Test Sites

Verglimit was first used in Ontario in 1977 at two locations. It was placed on a trial basis as a HM patch on Hwy 48 at Ringwood and on the deck of the Black Horse Bridge on Hwy 9. It was subsequently placed at a further 11 sites during the period 1979-84. All the sites are listed in Table 1.

Most of the Verglimit pavements are still exposed and in service; however, the following are not:

Highway 11 - Vernon Narrows Bridge, Huntsville Bypass -- An uneven pavement was placed and severe ravelling occurred, possibly due to lack of compaction. The Verglimit was replaced with regular HL-1 in the spring of 1981 after only one winter in service.

Highway 22 - Medway River Bridge, west of London -- The pavement placed on the deck of this bridge was uneven and was removed and replaced.

In the summer of 1983, the Verglimit surface courses were sampled to determine if the de-icing compound was still present. The physical performance of the Verglimit at the test sites was monitored over one winter season (1983-1984). Accident reports for the sites were reviewed for the period from early 1978 to 1985.

3/ Presence of Verglimit

In the summer of 1983, cores were taken from three of the test sites to determine if the de-icing compound was still present in the pavement after being exposed for a number of years. The following sites were chosen due to their proximity to Toronto and convenience in sampling:

- Highway 9 - Black Horse Bridge (1977)
- Highway 48 - HM Patch, north of Ringwood (1977)
- Highway 11 - CNR Bridge, Huntsville Bypass (1980)

The pavements were tested in the field for reaction with silver nitrate ($AgNO_3$) as were the cores after they were removed to determine the presence of the de-icing compound. The surface of the Verglimit pavements showed a moderate to good reaction in all cases. The cores were broken and $AgNO_3$ applied to the freshly broken faces. A good reaction occurred with all the cores, indicating that the calcium chloride ($CaCl_2$) was still active within the pavement at all three locations. These tests showed that the $CaCl_2$ flakes were still in solid form in the pavement after 3-6 years, indicating that the $CaCl_2$ was not migrating out of the pavement either to the surface or to the bridge deck below.

4/ Observations of Physical Performance

The performance of the Verglimit sections over the 83/84 winter season were monitored by MTC District Maintenance staff in accordance with procedures laid down by the Research and Development Branch. Observations were made of the following performance features:

- icing of bridge decks relative to the adjacent HM pavement on the approaches or to other structures close by;
- moisture "tracking" from the Verglimit pavement on humid days when the adjacent pavement was dry;
- in light snowfall conditions, any differences in clearing between Verglimit and the adjacent pavement;
- any visible differences in plowing between Verglimit and the adjacent pavement;
- any differences in traffic working snow and slush off the Verglimit and the adjacent pavement.

It should be noted that not all of the above features would be obvious at any one time. The assessment of these features and their effect were reported at intervals over the winter months. Table 2 summarizes the comments received for each Verglimit site.

Since the assessment of the performance of the Verglimit pavement was subjective and many different observers were involved, some variance in the reported performance might be expected for these reasons alone. Also, while the pavement performance was to have been monitored in the temperature range O°C to -5°C, it is quite possible that some of the monitoring may have taken place at colder temperatures when the benefits of the Verglimit pavment would not have been evident. With these qualifications, it appears that the performance of the Verglimit trial sections was not uniform.

Some trial areas appeared to be performing very well. There were obvious benefits apparent at those sites, either during or after snow storms or when the temperature dropped below the freezing mark. The benefits for the Verglimit sections were noted relative to the performance of the adjacent pavements or other structures decks in the immediate vicinity.

Of the 10 Verglimit pavements monitored, four of these showed markedly better performance than adjacent pavements or nearby structures. The following types of comments were recorded:

- less icy or less prone to icing;
- no frosting compared to other decks in the area;
- deck clears faster;
- no "special" attention required;
- no complaints by public or the police as in the past.

For example, the Madawaska Bridge on Hwy 17 showed the benefits for a Verglimit bridge deck when compared to an adjacent structure deck at the Bonnechere River. However, it appears that the performance of the Verglimit was less effective during the winter of 83/84 than in previous years. The Verglimit surface was in its third winter of service when this observation was made.

Of the five remaining sites, four indicated little or no difference in the performance of the Verglimit when compared with the adjacent HM pavement. Comments such as, "some clearing off early in storms" or "dries quicker, better traction when wet," were recorded, indicating only very minor benefits at best.

There were indications that the performance of one Verglimit pavement not on a bridge deck was poorer than the adjacent pavement. The site on Hwy 8 incorporated a steel slag aggregate in the surface course. When ice developed on the pavement, it was slower to melt on the Verglimit section. Also, light snow adhered to form a 0.3 m wide ice strip at the centreline which was not apparent on other pavements with conventional aggregates.

While the reason for the above performance is not clear, it is likely that the steel slag pavement exhibits colder pavement surface temperatures than a conventional aggregate pavement due to its inherent thermal properties. Thus, ice and snow would tend to form more easily on the pavement surface and remain for longer periods. Also, steel slag aggregate makes a pavement surface more wear-resistant; hence, less Verglimit would be exposed at any one time, or during a winter season, when compared with conventional pavements. Thus, the use of steel slag or similar slower-wearing aggregate appears to be counter-productive when used in a Verglimit surface pavement.

5/ Discussion of Physical Performance

In general, based on the results of the monitoring summarized in Table 3, it would appear that Verglimit is effective as a built-in de-icer in a least 50% of the trials. However, it appears that Verglimit becomes less effective with the passage of time, based on comments noted by the observers.

When Verglimit is first placed, its winter performance appears to be markedly better than the performance of the pavement which was replaced. As time passes, the Verglimit appears to lose some of its ability to reduce the icing phenomenon. This might be associated with the wearing qualities of the pavement, i.e., when a pavement is designed to be more stable and durable, less $CaCl_2$ will be exposed at the pavement surface to give the Verglimit pavement its desirable performance. This could be overcome by designing the pavement mix so that its useful life would be reduced somewhat, but so that the desirable properties of Verglimit could be utilized. However, the additional long-term cost of this compromise must be kept in mind. It should be noted that MTC Verglimit mixes have used 5.0% by weight while current design practices by the manufacturer call for a minimum of 5.5 to 6.5% Verglimit to produce the desired results.

Almost half of the trial Verglimit sites exhibited performance which was no different from the adjacent HM pavement. The monitoring of the Verglimit performance was to have been carried out in the temperature range of about 0°C to -5°C. This is the temperature range in which Verglimit is considered to be effective, according to the manufacturer. While some of the comments received from the Districts refer to the effectiveness of Verglimit at this temperature range, all comments referring to lack of any difference in performance between the Verglimit and adjacent pavements or bridge decks in the vicinity failed to mention this temperature range or near freezing conditions.

As a result, one might wonder whether some of the observers were making their observations at temperatures outside of the effective range claimed for the product. For example, at -15°C, no difference would be evident in the performance of the Verglimit compared to the adjacent pavement, but none would be expected. Since the narrow temperature range or near freezing conditions occur for a very limited period of the winter, it is important that observations should be limited to this temperature range, otherwise misleading results could be obtained as to the effectiveness of a Verglimit pavement.

The one example of Verglimit performance being poorer than that of the adjacent pavement illustrates the difficulty of trying to do two different things with one pavement design, i.e.:

1) utilizing a slow wearing aggregate for better durability; and

2) using a Verglimit design which prevents icing at near freezing temperatures but is dependent on the continual wearing of the pavement surface to expose the $CaCl_2$ particles contained within the pavement.

The two purposes are not compatible and the experience indicates that Verglimit should only be used in combination with slag aggregate where traffic volumes are very high.

While the results of the study are not conclusive, it does seem that the Verglimit placed in a surface wearing course can be effective, as claimed by the manufacturer. The reasons for its ineffectiveness at some sites are not fully understood. A further season of closer monitoring, particularly within the narrower below-freezing temperature range, would appear desirable and necessary.

6/ Cost of Verglimit Mix

The addition of Verglimit to a bridge pavement greatly increases the cost of the pavement. The following factors contribute to the high cost of the mix:
a) cost of Verglimit,
b) plant modifications,
c) additional labour and equipment,
d) reduced plant productivity.

For smaller Verglimit jobs, batch plants are commonly used and do not tie up costly production facilities. Verglimit is packaged in 25 kg bags for this use.

For bigger jobs, continuous mix drum plants can be used, but these will require modifications. The Verglimit must be introduced past the flame in the lower part of the drum into the mix. Verglimit is sensitive to heat and cannot be exposed to flame or excessive heat. It is now packaged in 1 tonne bags for continuous mix drum plant use.

The cost of a Verglimit mix utilizing a conventional batch plant is estimated to be about three times the cost of a conventional mix. The major contributor to the cost increase is the purchase of the Verglimit which is currently quoted at about $1345/tonne, FOB, Hamilton. Verglimit is manufactured in Cologne, West Germany, and imported into North America.

7/ Accidents at Verglimit Sites

Accident records were reviewed for the '77/78 winter to the '84/85 winter for various bridge sites on which Verglimit was placed. The earliest computer printouts available start in the late '77/78 winter. For each site, the records were reviewed for the winter period from October to April. The accident record search was narrowed down to the section of highway in each area which was in the immediate vicinity of the bridge, so as to avoid reviewing accidents which might not be related to the Verglimit. The raw data for the accidents are listed in Table 4.

The following discussion is based on the information recorded on the computer accident printouts which are limited in the accident information provided.

The records indicated a total of 32 accidents in the immediate area of the Verglimit pavements. Eight of the accidents occurred before the Verglimit was placed and 24 accidents occurred after the Verglimit placement. The time frames before and after the placement were not the same. Twelve of the accidents appeared to be bridge related and 20 accidents highway related.

It is difficult to assess the effects of the Verglimit pavement. The expected benefits of the Verglimit are in the 0°C to -5°C range. Observations of pavement conditions such as 'dry, slush, packed snow and ice,' could occur above, as well as below, the effective temperature range. Thus, there is no positive way of determining whether an accident occurred at the time Verglimit would be expected to improve the pavement conditions or whether the temperature at the time of the accident was outside of the range in which Verglimit was considered to be effective.

A statistical analysis of the accidents, both before and after placement of Verglimit at the various sites, could not be carried out due to the limited amount of data available.

A summary of the accident data, showing the visibility and surface pavement conditions at the time of each accident, is shown in Table 5. Of 32 injuries arising from the accidents, four were related to bridge accidents with the remaining 24 highway related.

In both the injury and property damage resulting from accidents on or near these structures, it would appear that the greatest property damage and injuries result from highway-related accidents as opposed to bridge-related accidents.

8/ Conclusions and Recommendations

1. The use of Verglimit pavement should be considered for those bridge decks which, based on current or previous experience, exhibit the icing phenomenon. The positive performance of the Verglimit pavement, noted in at least 50% of the trial sites, suggests that it can be effective in those bridge decks exhibiting hazardous performance in temperatures just below freezing.

2. The cost of a Verglimit mix is about three times the cost of the same mix without Verglimit. However, the quantity of surface course mix required for a bridge deck is relatively small. High cost appears to preclude the more general use of Verglimit in pavement surfaces.

3. Verglimit should be used primarily in southern Ontario. Since the effectiveness of Verglimit is limited to just below the freezing point, the maximum exposure would be obtained in the southern part of the province where the fluctuations around the freezing point would be most numerous and mid-winter thaws are experienced. Verglimit's effectiveness in the northern part of Ontario would be more limited due to the colder temperatures there. However, its use might be justified on bridges which are known to "ice over" on a number of occasions early in the winter season and for which the number of accidents is high.

4. Verglimit pavement could be designed so that it will wear faster in order to provide more exposure of the Verglimit during the winter season. This may shorten pavement surface life but will give the Verglimit an opportunity to reduce the hazards of the icing phenomonon, which is its intended purpose. The additional cost of this design must be considered.

5. The Verglimit mix design used by the Ministry has differed in the minimum percentage of Verglimit used, i.e., MTC used 5.0% minimum but the manufacturer recommends a 5.5% minimum Verglimit. The optimum proportion of Verglimit in relation to effectiveness and mix design variables needs further exploration (see 4).

6. Verglimit should not be used in a pavement design utilizing steel slag aggregate except where traffic volumes are very high. The thermal properties of the slag aggregate appear to be quite different from conventional HM aggregate and result in icing or ice retention in a temperature range different to that of conventional pavement aggregates.

7. Further monitoring of the Verglimit pavement trial sections should be carried out to see if the present findings still hold with time. Emphasis should be placed on monitoring the performance of Verglimit in the just below freezing range (0°C to -5°C), which is the effective range claimed by the manufacturer.

Table 1/ Test Site Locations

HWY	Bridge Site Number	Contract	Location	Year Placed
6N	0002	82-61	Grand River Bridge, Caledonia Bypass	1983
7	0061	83-57	Otonabee River Bridge, Peterborough Bypass	July 1984
8			Surface course on Osler Road, Regional Road 308, opposite Town Hall, Dundas	1979
9	0364		Black Horse River Bridge, west of Tottenham Road (CNR)	Oct. 1977
11	0017	78-106	CNR Bridge (NB), north of Vernon Narrows, Huntsville Bypass	July 1980
11*	0018	78-106 (HL1)	Vernon Narrows Bridge (SB), Huntsville Bypass	Oct. 1980
12	0074	83-57	Atherley Bridge	1983
17	0143	80-27	Madawaska River Bridge, Arnprior	1980
22*	0230		Medway River Bridge, west of London	1978
48			Hot mix patch 600 m north of Hwy. 47, Ringwood	Oct. 1977
121			Fenelon Falls Bridge connecting link	1983
126	0436	80-39	Thames River Bridge, London	1980
401	0100	80-57	Gananoque River Bridge	Summer 1980

** Verglimit no longer in service — resurfaced.*

Table 2/ Summary of Physical Performance Observations

Highway and Location	Report Date	Icing Relative to Adjacent Hot Mix Pavement	Difference in Clearing Light Snowfalls	Moisture Tracking onto Adjacent Pavement	Difference in Plowing	Traffic Working Slush & Snow	Remarks by Observers
Highway 6N Grand River Bridge, Caledonia Bypass	84 01 09	Verglimit slushy while HM pavement covered and icy.	Verglimit clears quicker.	None	No difference	Verglimit clears quicker.	Verglimit seems to melt snow quicker.
	84 04 24	Verglimit is less prone to icing.					Conditions have remained similar to previous report.
Highway 8 Dundas-Osler Drive, Reg. Road 306	84 01 14	Verglimit ice does not melt as quickly as on adjacent pavement.	On Verglimit, light snow adheres to form a 0.3 m strip at the centreline. Not apparent on other roads.	None since material first placed.	No difference.	No difference.	Steel slag aggregate slows the wearing of pave- ment to expose $CaCl_2$. Softer aggregate may have allowed greater release of Verglimit.
Highway 9 Black Horse Bridge	84 02 06	No significant difference.	No difference.	None.	No noticeable difference.	No difference.	Verglimit dries quicker, gives better traction when wet.
	84 04 27	No difference.	No difference.	None.	No noticeable difference.	No difference.	No change since last report.
Highway 11 CNR Bridge, Huntsville Bypass	84 02 07	No difference.	No difference.	None.	No difference.	No difference.	No apparent differences (daily records).
	84 03 02	No difference.	No difference.	None.	No difference.	No difference.	As above.
	84 04 03	No difference.	No difference.	None.	No difference.	No difference.	As above.
Highway 12 Atherley Bridge	84 02 06	Deck does not ice up as in past (almost daily).	At times, the Verglimit bares off faster than the approaches in -4°C to 0°C range. Verglimit also bares off faster than road on colder days.	Tracking no longer a problem at -5°C to -8°C.			Definite improvement compared to past winters. Deck no longer requires "special" attention, i.e., sanding. (Note: Channel does not freeze over in winter.)
	84 05 07						No significant change from last report.
Highway 48 N. of Ringwood (patch)	84 02 03						No apparent difference between Verglimit and adjacent pavement.
	84 04 30						As above.

Table 2 (cont.)/ Summary of Physical Performance Observations

Highway and Location	Report Date	Icing Relative to Adjacent Hot Mix Pavement	Difference in Clearing Light Snowfalls	Moisture Tracking onto Adjacent Pavement	Difference in Plowing	Traffic Working Slush & Snow	Remarks by Observer
Highway 17 Madawaska River Bridge	84 02 29	Does not ice up as much as Bonnechere deck. Not as good as last year.	Light snow melted off deck in earlier years, but not this past winter.	No problem at any time.	No apparent difference.	Snow works off deck faster than adjacent pavement, but not as fast as in previous years.	Verglimit appears to be less effective than in previous years.
	84 05 16 (for Feb)	No difference.	No difference this year in light snowfalls. Was a difference in past years.	No problem.	No difference.	As above.	Storms only in last week of February. No apparent difference between Verglimit and adjacent pavement.
	84 05 16 (for Feb)						Snow storms only in first week of March. No apparent difference between Verglimit and adjacent pavement.
Highway 121 Fenelon Falls Bridge	84 01 03	Verglimit does not ice over as occurred in past.	Verglimit slushes up quicker than adjacent pavement.	None.	No difference.	Slush clears off Verglimit faster than adjacent pavement.	
	84 02 03		Verglimit slushes up quickly in milder weather. No difference at -25°C.				
	84 05 07	Verglimit less icy in cold weather than adjacent pavement.	Verglimit slushes up quicker in milder weather (-4°C to +5°C).	None.	No difference.	No difference.	Verglimit good. Deck did not require special attention in all types of weather conditions. No complaints by public or police.
Highway 126 Thames River Bridge	84 03 16	Verglimit less icy than adjacent pavement or other decks.	Snow does not adhere to Verglimit and clears faster than on adjacent pavement.	None.	Becomes track bare before rest of pavement.	Traffic works snow and ice off deck much quicker than on adjacent pavement.	Little or no frosting on Verglimit compared to other decks. Verglimit requires repairs — breakup and potholes.
							No problems experienced.
Highway 401 Gananoque River Bridge	83 12 08						No appreciable difference between Verglimit and adjacent pavement — desired results not being obtained from Verglimit over past three winters.
	84 01 02 03 24	No difference in any type of storm.					Bridge deck still gets icy.
	84 07 11						No obvious change in the pavement conditions during and after storms. Possibly some clearing off early in the snow storm.

Table 3/ Summary of Verglimit Performance

Verglimit Showing Better Performance than Approaches	
Highway 6N	— Clears quicker; less prone to icing.
Highway 12	— Does not ice up as in past; bares faster; definite improvement; no "special" attention (open water).
Highway 121	— Less icy; slushes up quicker; slush clears quicker; no special attention; no complaints as in past.
Highway 126	— Less icy; clears faster; slush works off; no frosting compared to other decks; Verglimit requires some repairs.
Verglimit Showing Some Difference in Performance from Approaches	
Highway 17	— Does not ice up like Bonnechere deck. — Snow works off deck faster. — Less effective than in previous years.
Verglimit Showing No Difference in Performance from Approaches	
Highway 9	— Dries quicker; better traction when wet.
Highway 11	— No difference.
Highway 48	— No difference.
Highway 401	— Possibly some clearing off early in storms.
Verglimit Showing Poorer Performance than Approaches	
Highway 8	— Verglimit ice slower to melt. — 0.3 m wide ice strip along centreline — Note: Steel slag used.

Table 4/ Accident Data

Winter of 19..	Hwy No.	Bridge Related	Highway Related	Visibility	Surface Conditions				No. of Injuries	Property Damage in $1000	Date of Placement
					Dry	Wet	Slush	Ice			
77/78	12	x		Clear				x	0	2.8	1983
78/79	9		x	Clear	x				1	1.2	1979
	401		x	Clear	x				0	0.8	1980
	11	x		Snow/sleet			x		0	0.4	1980
	12	x		Clear			x		0	2.5	1983
79/80	12		x	Clear	x				2	1.2	1983
80/81	11		x	Clear	x				3	2.0	1980
	12		x	Rain		x			3	3.0	1983
	22	x		Clear		x			2	1.0	1978
	22		x	Rain		x			0	0.6	1978
81/82	9		x	Clear	x				0	2.5	1979
	11		x	Snow/sleet				x	0	2.6	1980
	12	x		Clear				packed snow	0	0.4	1983
	17		x	Clear	x				0	1.5	1980
	17		x	Clear	x				6	11.5	1980
82/83	9	x		Snow/sleet				x	0	0.8	1979
	9		x	Snow/sleet				x	1	10.0	1979
	401		x	Clear				x	1	0.9	1980
	401		x	Rain				x	2	2.0	1980
83/84	9		x	Snow/sleet			x		0	2.5	1979
	9	x		Rain				x	2	12.0	1979
	11	x		Clear			x		1	8.0	1980
	7	x		Clear				x	0	1.0	1984
	22		x	Fog, mist Smoke, dust		x			1	3.0	1978
84/85	6		x	Clear	x				1	0.1	1983
	22		x	Clear	x				0	0.2	1978
	22	x		Clear				x	3	5.0	1978
	401		x	Clear	x				0	0.8	1980
	401		x	Clear		x			3	6.9	1980
	401	x		Snow/sleet				x	0	1.2	1980
	6		x	Clear	x				0	1.3	1983
	7	x		Clear	x				0	2.0	1984
Totals	—	12	20	—	12	5	4	11	32	91.7	—

Table 5/ Accident Summary

Highway Number	Accidents		Bridge Related		Highway Related	
	Before	After	Visibility	Surface Condition	Visibility	Surface Condition
6	0	2			2) Clear	Dry
7	(new)	2	1) Clear	Ice		
8	0	0	1) Clear	Dry		
9	1				1) Clear	Dry
		5	1) Rain	Ice	1) Clear	Dry
			1) Snow/sleet	Ice	2) Snow/sleet	1) Slush
						1) Ice
11	1		1) Snow/sleet	Slush		
		3	1) Clear	Slush	1) Clear	Dry
					1) Snow/sleet	Ice
12	5	0	3) Clear	1) Ice	1) Clear	Dry
				1) Slush	1) Rain	Wet
				1) Packed snow		
17	0	2			2) Clear	Dry
22	0	5	2) Clear	1) Dry	1) Clear	Dry
				1) Ice	1) Rain	Wet
					1) Fog, mist, smoke, dust	Wet
48	0	0				
121	0	0				
126	0	0				
401	1				1) Clear	Dry
		5	1) Snow/sleet	Ice	3) Clear	1) Dry
						1) Wet
						1) Ice
					1) Rain	Ice
Totals	8	24	12		20	